

## VIRTOOLS AND ITS APPLICATION IN MOCAP AND CREATION OF THE SCRIPTS FOR ANIMATIONS OF MODELS

Jozef NOVAK-MARCINCIN – Veronika FECOVA – Ludmila NOVAKOVA-MARCINCINOVA  
Miroslav JANAK – Jozef BARNA – Marek KOCISKO

**Abstract:** *In this progress period technicians and companies very often need to simulate some events such as people walking or moving some objects from one place to another. This contribution is focused on one kind of virtual reality (VR) - MOCAP (Motion Capture) and on the creation of graphical scripts for the animation of models. VR is used also in the process of workplace design. Firstly, the workplace is designed and prior to its real building there are different conditions simulated. Once the manufactory is optimally designed, the realization of its building starts. VR has a very important role in these stages, because it can bring significant financial savings. The result of this simulation is a workplace, which makes provision for ergonomic requirements as badly designed workplace increases additional costs and assembling time. Currently, most companies try to prepare the projects of new products by simulations and analyses rather than assumptions or conjecture.*

**Keywords:**

- virtual reality
- Virtools
- simulation
- animation

### 1. INTRODUCTION

In today's progress period technicians often need to simulate some natural events such as people walking or moving some objects from one place to another.

Virtual reality (VR) is simulation of the real or fictive environment which can be visually sensed to all the dimension of space: height, width and depth. Its perfection depends on the advance of used devices as a head-mounted display, data gloves or data suits [1], [2], [4], [5].

Currently, most companies try to prepare the projects of new products and manufactories by simulations and analyses instead of assumptions or conjecture. At the beginning the workplace is modelled and there are different conditions simulated before its real initiation of building. Personnel are moving among virtual machines and monitoring their location. In case of a new idea, the plan is reconditioned and the user is moving to the new area again. Once the manufactory is optimally designed, the realization of its building starts. VR

has very important role in these stages, as it can bring significant financial savings [7], [8], [12].

The manual assembling is simulated together with consideration of ergonomic aspects, for example whether the worker will have enough space for the hands and assembled components and whether he will have a good view for the task realization (Figure 1). The result of this VR simulation is presented as the workplaces, which make provision for ergonomic requirements. This technology is mostly used for automotive and aerospace industries [9], [10], [14].



Figure 1. VR in car assembly process [7]

## 2. OPTICAL MOCAP - ARTTRACK2

The optical systems can use the active or passive markers. Active markers emit light and passive markers are coated with retro-reflective material which reflects the light back.

This article describes the system ARTtrack2 (Figure 2). This system uses passive rigid-body targets. These markers are back-reflecting the incoming IR radiation into the direction of the incoming light. The IR radiation is back-reflected into a narrow range of angles around the (opposite) direction of the incoming light. These markers are mostly spheres covered with retro reflecting foils, but they can also be in the form of stickers made of retro reflecting material. This passive system does not require wearing of wires or electronic devices within the user. Markers are usually attached directly to the user [11].

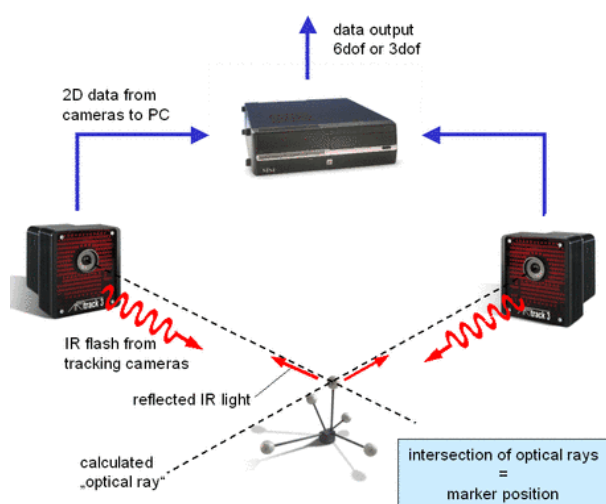


Figure 2. Principle of passive targets [11]

At least two, maximally up to 16 tracking cameras are needed for this system. An infrared light flash is not visible for the human eyes. The ARTtrack2 IR-camera is a good solution for distances up to 4 meters.

The calibration of targets is very fast and simply. The identification of a rigid body is based on the distances between single markers on a target. This means, that each target has to show a unique set of marker distances [3].

For head tracking in passive stereo systems, tracking targets must be fixed to the stereo glasses and other targets are attached directly to the user (Figure 3).



Figure 3. Passive targets [11]

## 3. VIRTOOLS

One piece of software widely used for 3D visualization is Virtools (Figure 4). The following picture shows the interface and location of the main windows. It is software which allows for a quick and easy creation of the virtual world. The creation of models in Virtools isn't possible, but simple elements such as cameras, lights, rooms and standard media such as images, sounds, animations and models can be created by the click on an icon in Virtools Resources. This software uses the creation of graphics script describing the behaviours of components from the virtual world. It is much more user-friendly than employing the text script [13].

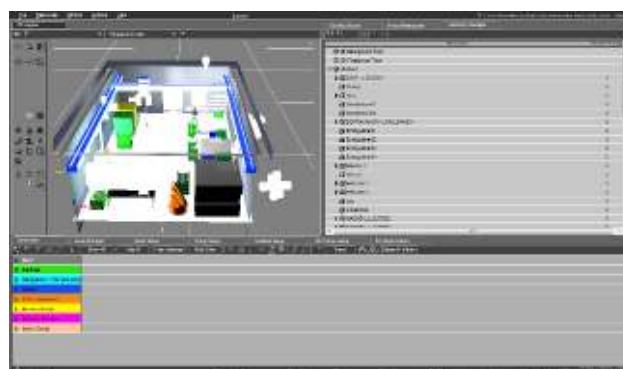


Figure 4. Virtools

## 4. APPLICATION WITH ARTTRACK2 AND VIRTOOLS

This example shows how ARTTrack2 and Virtools can be used. It is an example of motion in the virtual hall that copies the user's moving. Examples of using this system are shown in Figure 5 and

Figure 6. The production hall along with various devices has been modelled in Pro/Engineer system. After initiation of the optical system, the calibration of this system is running so that the “walking” in a virtual production hall would be possible. When the user stands on the place and once the calibration has been performed, he stands also in the virtual hall environment. The direction of his movement then corresponds with the movement in the virtual world. When the user is close to the calibration position, his speed of walking in the virtual world is slow. The further he is, the faster his speed is. The user is able to try some conditions of a newly designed hall, as for example the location of machines. He can also test whether he will have enough place for passing and crossing between machines with working material.



Figure 5. Walking in the virtual production hall

In this solution, even if the user doesn't move, he is still moving in the virtual production hall. If he wants to stand still in the virtual world, he has to go back to the calibration position.

It is a good and simple solution. In this example the user can also try to utilize the virtual worker. He controls the figure so that he can manipulate with his hands and check, whether the virtual worker has

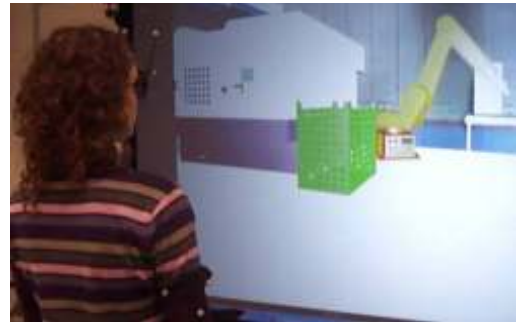


Figure 6. Walking in the virtual production line

enough place for components of the assembly process, for his body, or the working view.

Sometimes, there is a need to deactivate or activate some scripts. A little part of this script is shown in the Figure 7. At the start of this script there is an order for deactivation of a particular script, then there is a setting of a new position of the camera. After that, the new script can be activated.

## 5. ANIMATION OF MODELS

The window “Schematic” is important for creating animation and for adding of motion capture devices (Figure 8).

If the user needs to create the script to animate models taken from the virtual world, a robot for example, the right setting of hierarchy of model's parts is very important. The hierarchy of parts is changed in the window “Hierarchy Manager” (Figure 9). The use of “drag and drop” function is allowed. If these settings are wrong, the animation of the parts will be incorrect. All parts need to have right parents and all parents need to have proper children.

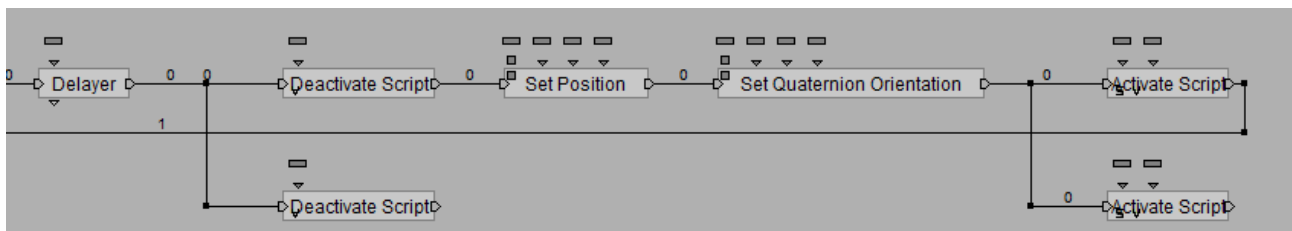


Figure 7. Part of graphic script

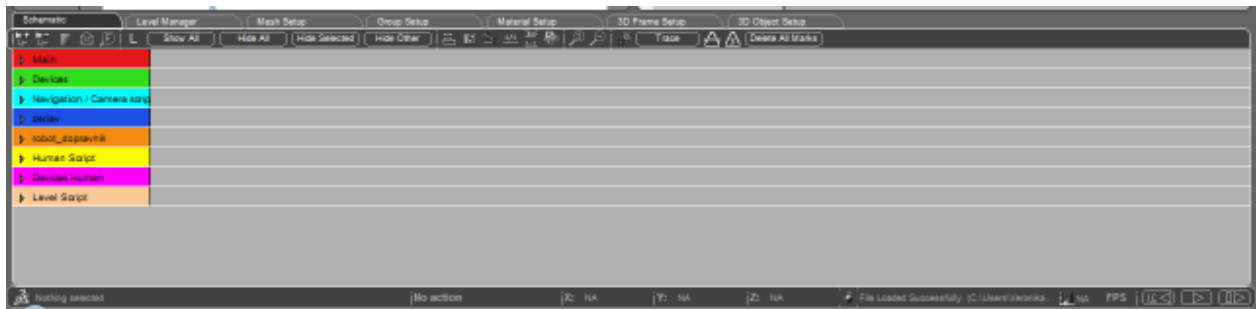


Figure 8. Window for creation of graphic scripts

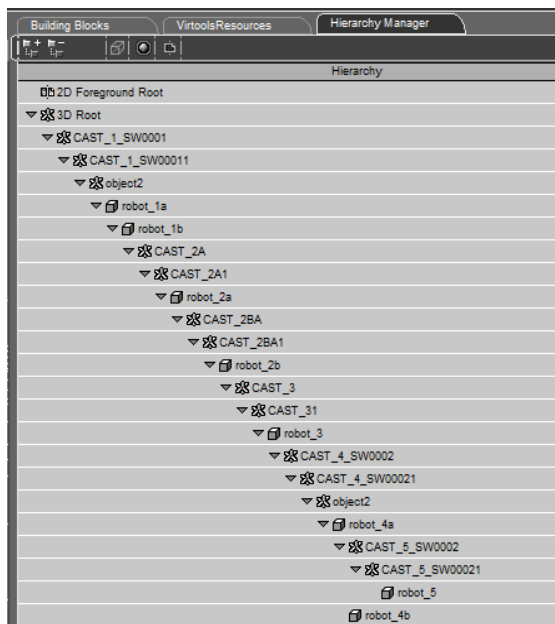


Figure 9. Hierarchy Manager

The animation of a crane will be activated when the „Z” button of the keyboard is pressed. The orders “Bezier Progression” and “Translate” are used for the creation of this script (Figure 10) that is very simple.

At the start the “Key Waiter” is set. The “Bezier Progression” interpolates a float according to a 2D

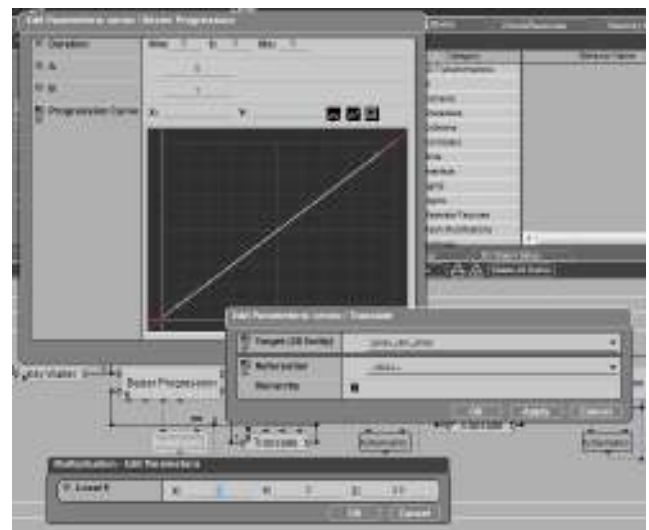


Figure 11. Setting of needed parameters

Bezier curve in the [Min, Max] range, in a given number of milliseconds. In the “Translate” parameter, the 3D target is set and “Multiplication” is added in parameter operation, which defines the vector for moving (Figure 11).

The script for the animation of the robot is similar to the script for a crane, but “Translate” is not used in this case. A “Rotate” order is used, because the parts of a robot are rotating with no translation.

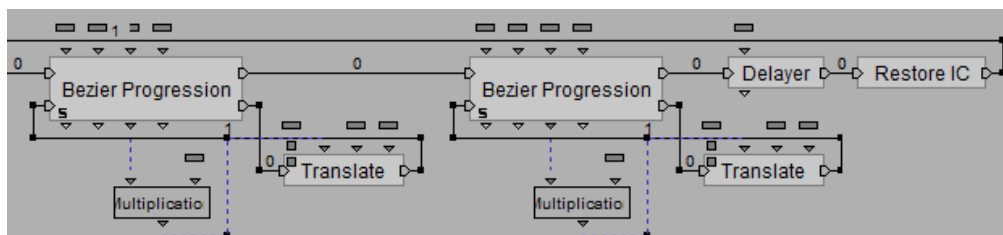


Figure 10. Script for the animation of crane



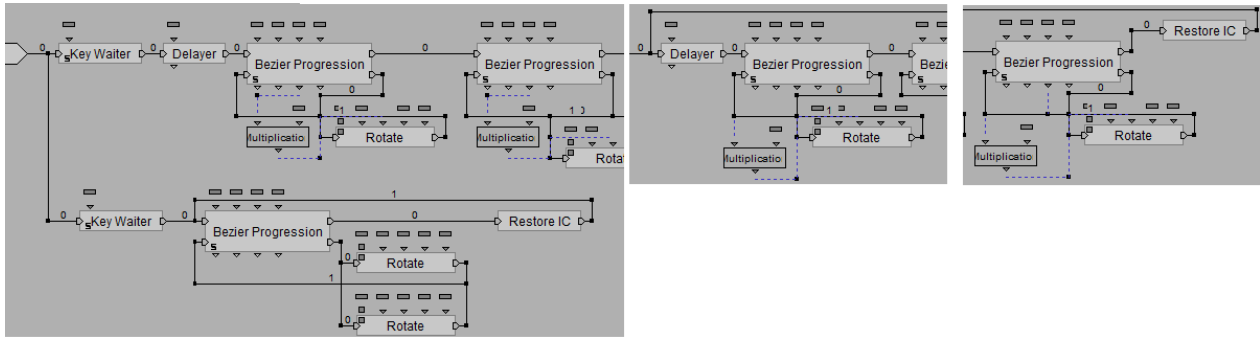


Figure 102. Script for the animation of robot and conveyor

In the Figure 102 there is an entire script shown and in its bottom part there is the part providing the animation of the conveyor – the rotation of shafts. Firstly, the parameter of the operation “Multiplication” was not used. The parts of a robot were rotated, but when the view changed, the animation was different. The set of references was applied, but it did not work. Then the “Multiplication” was added and the animation was corrected. It was working even after the change of the view. The last order “Restore IC” – restores initial conditions, is linked with the part of the script, where the motion regarding the transport of components from the container to the conveyor gets started. This order isn't linked with the start of the script, because primary motions of the robot were realized from an initial position to the position of the start of components transfer.

Edit of some orders from this script is shown in the Figure 11.

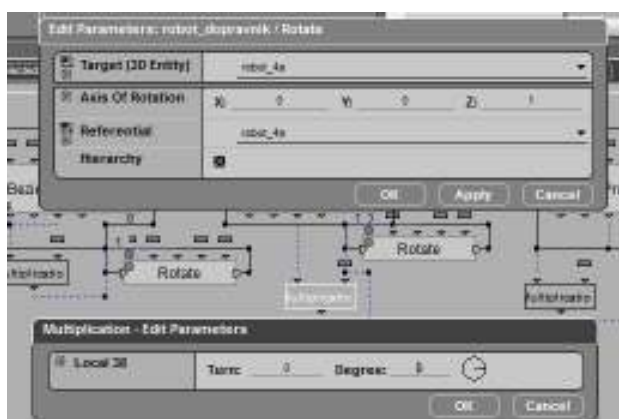


Figure 11. The setting of parameters for shafts

In the Figure 124 and Figure 13 there are shown animations of both the robot and conveyor. The

robot holds the component and puts it on the conveyor [6].



Figure 12. Animation of robot – 1



Figure 13 Animation of robot – 2

## 6. CONCLUSION

In the time of technical progress, technology of virtual reality is often used in the automotive and aerospace industries. Technicians in modern companies very often need to realize the simulation of some workplace before its real initiation of building. For this simulation, the virtual reality is a perfect solution. With this system the user can try to walk in the virtual production hall and he can also

see whether the space between machines is big enough for workers and used objects and materials. At the beginning the workplace is modelled and different conditions are simulated prior to its real building initiation. If the manufactory is optimally designed, the realization of its building can start. VR technology can be used also in the design process. The user can test the worker's arm reach, whether the assembly can be built and can also check whether the worker has enough space and in which positions his body can be situated. It is important as possible subsequent health and safety issues because the labour turnover and new training realization can present enormous difficulties for companies. With the utilization of these applications the companies can test the working conditions and save their money.

## 7. ACKNOWLEDGEMENT

The Ministry of Education, Science, Research and Sport of SR supported this work, contract VEGA No. 1/0032/12, KEGA No. 002TUKE-4/2012 and ITMS project 26220220125.



## 8. LIST OF SYMBOLS

|                    |        |   |
|--------------------|--------|---|
| Virtual reality    | VR,    | - |
| Motion capture     | MOCAP, | - |
| Initial conditions | IC,    | - |

## REFERENCES

- [1] Barna, J., Fecova, V., Janak, M.: *Power tool for development environment for creation of 3D real-time applications*, Journal of Engineering and Technology for Young Scientists, Vol. 1, No. 1, 2010, pp. 5-10.
- [2] Burdea, G. C., Coiffet, P.: *Virtual Reality Technology*, Second Edition, John Wiley&Sons, Inc., New Jersey, 2003.
- [3] Chang I.-Ch., Lin S.-Y.: *3D motion tracking based on a progressive particle filter*, Pattern Recognition, Elsevier, Vol. 43, 2012.
- [4] Jenkins, O. Ch., Gonzales, G., Loper, M.: *Tracking Human Motion and Actions for Interactive Robots*, HRI, 2007, pp. 365-372.
- [5] Jung, Y., Yeh, S.-Ch., Stewart, J.: *Tailoring Virtual Reality Technology for Stroke Rehabilitation: A Human Factors Design*, Work-In-Progress, 2006.
- [6] Li, R., Taskiran, C., Danielsen, M.: *Head Pose Tracking and Gesture Detection Using Block Motion Vectors on Mobile Devices*, Proc. of the 4th Int. Conf. on Mobile Technology, Applications and Systems, 2007, pp. 572-575.
- [7] Novak-Marcincin, J.: *Theory and practice of virtual manufacturing*, Manufacturing Engineering, 2/2007, pp. 85-91.
- [8] Novak-Marcincin, J.: *Application of the Virtual Reality Modelling Language in Automated Technological Workplaces Design*, Engineering Review, Vol. 27, No. 1, 2007, pp. 1-6, ISSN 1330-9587.
- [9] Novak-Marcincin, J., Brazda, P., Janak, M., Kocisko, V.: *Application of virtual reality technology in simulation of automated workplaces*, Technical Gazette, Vol. 18, No. 4, 2011, pp. 577-580, ISSN 1330-3651.
- [10] Novak-Marcincin, J., Doliak, M., Hloch, S., Ergic, T.: *Application of the Virtual Reality Modelling Language to Computer Aided Robot Control System ROANS*, Strojarstvo: Journal for Theory and Application in Mechanical Engineering, Vol. 52 No. 2, 2010, pp. 227-232, ISSN 0562-1887.
- [11] Novak-Marcincin, J., Fecova, V.: *The options of motion tracking in the virtual reality systems*, TMT 2010: 14th International Research/Expert Conference Trends in the Development of Machinery and Associated Technology, Mediterranean Cruise, Vol. 14, No. 1., 2010, pp. 361-364.
- [12] Ong, S. K., Nee, A. Y. C.: *Virtual and Augmented Reality Applications in Manufacturing*, Springer, London, 2004.
- [13] Raskin, L., Rudzsky, M., Rivlin, E.: *Tracking and Classifying of Human Motions with Gaussian Process Annealed Particle Filter*, ACCV, Springer, Part I, pp. 442-451.
- [14] Sherman, W. R., Craig, A. B.: *Understanding Virtual Reality. Interface, Application, and Design*, Elsevier Science, San Francisco, 2003.

Received: 04.02.2012.

Accepted: 15.03.2012.

Authors' address:

Jozef Novak-Marcincin  
Veronika Fecova  
Ludmila Novakova-Marcincinova  
Miroslav Janak  
Jozef Barna  
Marek Kocisko  
Faculty of Manufacturing Technologies TU Kosice  
Bayerova 1, 080 01 Presov, Slovakia  
jozef.marcincin@tuke.sk,  
veronika.fecova@tuke.sk,  
ludmila.marcincinova@tuke.sk,  
miroslav.janak@tuke.sk,  
jozef.barna@tuke.sk,  
marek.kocisko@tuke.sk

